Describing and comparing the availability of acute care resources to treat new onset stroke in different income settings: a self-reported survey of acute care providers at the 2016 international conference on emergency medicine

by

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Ramadhan Chunga

Declaration

By submitting this dissertation electronically, I, Ramadhan Mohamed Chunga declare that the entirety of the work contained therein is my own, original work, that I am the sole author thereof (save to the extent explicitly otherwise stated), that reproduction and publication thereof by Stellenbosch University will not infringe any third-party rights and that I have not previously in its entirety or in part submitted it for obtaining any qualification.

This dissertation includes one original paper published in peer reviewed journal. The development and writing of the papers were the principal responsibility of myself and for each of the cases where this is not the case a declaration is included in the dissertation indication the nature and extent of the contributions of co-authors.

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Date: ……

Table of Contents

List of tables and figures

Abbreviations

AHA	American Heart Association
ACLS	Advanced Cardiovascular Life Support
ASA	American Stroke Association
BLS	Basic Life Support
CKMB	Creatinine Kinase Muscle/Brain
CT	Computed Tomography
DALYs	Disability Adjusted Life Years
ED	Emergency Department
ECG	Electrocardiography
EMS	Emergency Medical Services
FAST	Facial droop, Arm drift, Speech, Time
GBD	Global Burden of Disease
HICs	High Income Countries
HREC	Human Research Ethical Committee
IBM	International business machine corporation
ICEM	International conference on emergency medicine
IRB	Institutional Review Board
LMICs	Low- Middle Income Countries
MRI	Magnetic Resonance Imaging
MMed	Master of Medicine
NBCI	National Centre for Biotechnological Information

NIHSS	National institute of health stroke scale
NICE	National Institute for Health and Care Excellence
NCDs	Non-Communicable Disease
NGOs	Non-Governmental Organizations
NY	New York
SPSS	Statistical Package for the Social Science
WHO	World Health Organization
UN	United Nations
USA	United states of America
UK	United Kingdom

Part A: Literature review

Introduction to Literature Review

Stroke affects around 15 million people, and is responsible for 5 million deaths per annum globally.[1] It is a major contributor to the growing burden of non-communicable diseases (NCDs), which accounted for 68% of all deaths in 2012, up from 63% in 2008.[2] The last two decades have seen a major transformation in the field of stroke care with the emergence of evidence-based stroke detection, access to advanced care, and emergency management of stroke.[3] In contrast to the trend in low- and middle-income countries (LMICs), stroke mortality is on the decline in the high-income countries (HICs).[4,5] Even though the availability of resources varies considerably by geographic region and across LMICs and HICs, evidence suggests that the available resources in LMICs to implement international recommendations are largely inadequate.[5,6] Arguably it is unlikely that these policies and guidelines, which are almost exclusively developed in HIC settings, would similarly apply in LMIC settings at all.[6]

The aim of this literature review is to understand the complexities regarding the availability of resources to manage an acute stroke between various resource settings and to assess challenges and barriers to acute stroke care.

Specific objectives

1. To provide a very brief summary on the literature on stroke, with regards to definition, prevalence and management
2. To investigate the differences in the epidemiology of stroke between different income settings
3. To assess the differences in resource availability between various income settings to treat acute stroke
4. To understand the impact that resource limitation has on stroke outcome and mortality

Literature search strategy, including inclusion and exclusion criteria

A range of online medical and scientific databases including PubMed/Medline, Google scholar, Medline, NBCI and EMBASE were utilised to perform appropriate searches and obtain articles. Searches were conducted using various combinations of Mesh words, which included “stroke”,” causes of stroke”,“ stroke

prevention”,” low-income”,” high-income”, “middle income”, “Lower-middle”, “higher-middle”, “LMIC”,” Africa”,” HIC”,” differences”, “CVA”, “cerebro-vascular accident”. The following search terms and phrases were added to appropriate searched: “new onset stroke”, “Africa”, “high income countries”, “low and middle-income countries”, “stroke management in LMICs”, “availability of acute care resources”,” stroke prevalence in LMICS and HICs”. Articles were also sourced from references of articles that were already included, in a snowballing fashion. A summary of article selection can be found in figure 1. Abstracts and titles from identified articles were screened individually and full articles were sourced for those considered applicable.

Inclusion criteria

1. Publication date from 2005 until currently

2. Only English articles were included

Exclusion criteria

1. Irrelevant manuscript (abstract screening)

2. Languages, other than English (excluding those who were translated to English)

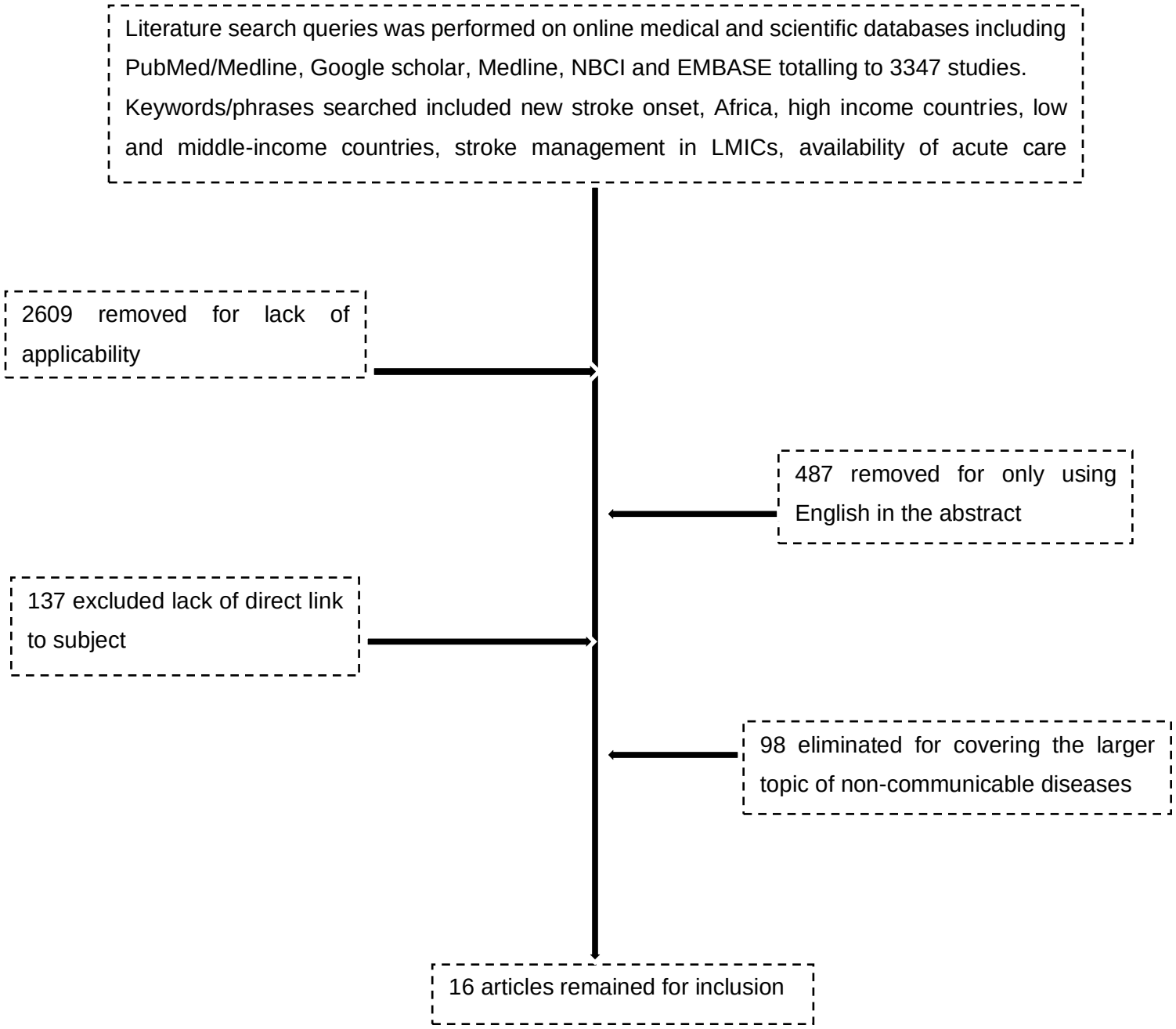
3. Articles requiring payment or subscription

4. Journals or articles with restricted access

Quality criteria

The abstracts of the included articles were screened for applicability, internal and external validity (Figure 1). High impact studies were included, and full articles obtained as mentioned above. No formal quality assessment was done as it was not required for MMed.

Figure 1: *Literature selection process*



Brief Literature Review

Introduction

Stroke is a major cardiovascular accident that follows death of cells as a result of blockage of blood or rupture of blood vessels in the brain.[7]. It is the second leading cause of death worldwide and the third cause of disability.[3]. 87% of stroke deaths and disability-adjusted life years occur in low- and middle-income countries.[8,9,10]. In the past four decades, the advancement of stroke intervention strategies in high-income countries has seen the incidence decline by 42%, In contrast, the incidence, in fact has doubled in low- and middle-income countries, with premature stroke death being more prevalent in LMICs. [4,8,11]. In addition to this, 84% of patients with a stroke in low- and middle-income countries and 16% in high income countries, die within three years of diagnosis.[11]

The statement from the American Heart Association (AHA) and American Stroke Association (ASA) emphasises that stroke has fallen from the third to the fourth leading cause of mortality in the USA.[12] This decrease could be attributed to the extensive resources and the implementation of evidence-based approaches that are supported by reputable organisations. The excessively higher burden and inconsistency between HICs and LMICs appear largely due to numerous barriers to implement evidence-based stroke care.[13] A comprehensive body of evidence also suggests that material resources to replicate recommendations of evidence-based stroke care from international guidelines are largely limited. The availability of health care resources, however, varies considerably by geographic region and across LMICs.[12,13] As little data and consistency exist on resource availability to implement stroke guidelines in countries with different gross national incomes as well as World Health Organization (WHO)'s regions, it is unlikely that policies and guidelines developed in high-income settings would similarly apply in LMICs.[14] The challenge thus lies in implementing internationally accepted guidance, particularly in LMICs where resources are limited.

Various guidelines are in place worldwide to guide the prevention and early management of stroke. However, most are developed from high resource settings.[15] The National Institute for Health and Clinical Excellence, (NICE) and AHA/ASA are considered the gold standards and their recommendations are adopted all over the world. The first NICE stroke guidelines were developed in 2004 and were updated in 2008. Nonetheless, the AHA/ASA developed a more recent guideline (2013), including an addendum update in 2015.[16] It is also more reputable across the LMICs due to the fact that the emergency cardiovascular care programs implemented by AHA (through Basic Life Support (BLS) and Advanced Cardiovascular Life Support, (ACLS)) all over the world utilise these guidelines.

Stroke burden in low- and middle-income countries

The prevalence of new onset stroke is on the rise in LMICs[18, 4, 5]. The severity of the situation is described in a report where it was estimated that there were 62 million stroke survivors and 16 million new stroke cases in 2005 across the globe.[18] The stroke-related deaths accounted for 9.7% of the overall fatalities globally. Further, by 2030, the fatalities are projected to increase from 6.8 in 2015 to 7.8 million while the number of new onsets of strokes are anticipated to increase to over 23 million, if the trends go unchecked.[16] The population growth, coupled with poor diet in western cultures,[19] unregulated industrialisation [20] excess smoking and alcohol consumption, contribute to the increasing stroke incidence, with LMICs and Africa the most affected.[19] Similarly, the prevalence of obesity and hypertension has increased, especially in children and women, with western diets and lifestyle. These factors are responsible for the increased occurrence of stroke globally, and more so in the LMICs.[21]

Investigations into the causes and effects of stroke in LMICs suggested that the increased prevalence in Africa is largely concentrated in the West African nations particularly Sierra Leone, Liberia and Angola.[22]. These countries contribute the largest number of DALYs and mortality rates world-wide as rendered by the Global Burden of Diseases (GBD) 2002 estimates.[23]. Another study investigating stroke pervasiveness between 2000 and 2004 noted an 8% increase in stroke prevalence and 5% survival in Africa.[21] The study highlighted unhealthy diets and uncontrolled industrialisation as key contributors to the ever-increasing levels of stroke cases in African countries.[3]

Stroke is envisaged as a burden on families of the affected irrespective of the income level of the country. The biggest burden however, independent of the severity of stroke, is felt in LMICs[4]. A report examining stroke incidence globally noted that there is a six years' age difference margin in cases of occurrence between HICs and LMICs.[4] The incident population in LMICs are not only younger, but also comprises of a higher proportion of women, most likely explained by the hypertension epidemic.

The distribution of the global burden of stroke and cardiovascular cases differs significantly among certain countries. Most Arab and European countries record a predominance of ischaemic cardiac disease over ischaemic stroke, while in Asian countries, the opposite is true.[5] Traditionally, most health care sectors have mostly focused on the management of infectious diseases and this can be historically and practically justified.[24]. For example, communicable diseases can easily be passed across boundaries, spreading fear and chaos to other countries.[24] The high death rates adds to the alarm and thus making the whole situation more noticeable. These circumstances surrounding the communicable diseases results in the investors (government, donors and Non-Governmental Organizations (NGOs) among others) in the health sector to assist with such cases.[3, 10] On the other hand, since stroke cases are not transferable from one patient to the

other, awareness is difficult to rise. The reduced investment on stroke indirectly translates to the morbidity and mortality associated with stroke, particularly in LMICs. Also, since most of these communicable diseases have a short-term impact, investors prefer to finance the response and management[25]. In contrast to this, investors often shy away from ailments that take longer to manage and require more resources, such as stroke.[25] Consequently, the burden of non-communicable diseases, including stroke, have continued to rise.

Prehospital delays as barrier to effective stroke care in LMICs

A diagnostic workup incorporating laboratory analysis, imaging and neurological examination is essential before thrombolysis can be considered, particularly to eliminate stroke mimics and intracranial hemorrhage. Diagnostic delays may prevent treatment in the permitted therapeutic window as observed in numerous LMICs.[26]. Numerous HICs have specialised centres that facilitate intravenous thrombolysis to 20-30% of ischaemic stroke patients.Thrombolysis improves functional outcomes at 3 to 6 months when given within 4.5 hours of ischemic stroke onset.[26] LMICs lacks specialised stroked centres that may contribute to diagnositc and therapeutic delays. A significant barrier in LMICs is the long delays before patients reach hospitals for definitive care, whether by emergency medical transport or by other means. Patients with ischaemic stroke in HICs that arrive at the hospital two to three hours after the onset of the stroke, are considered late and comprise only a small proportion. Patients in LMICs arrive on average five to twelve hours after the onset of symptoms.[16] This delays could be contributed to a lack of an established emergency transport system, by the condition of the roads, and poor communication and coordination of emergcny services[16]. Another contirbuting factor to delays in LMICs is a lack of general stroke awareness among the population. While delays in seeking for medical help ranges from 38 minutes to 4 hours in the UK and USA (HICs), most patients (between 24% and 54%) in LMICs do not call for help within an hour of stroke symptoms onset and others do not search for medical attention whatsoever.[26,27]

Stroke in high-income countries

Studies suggest that the patterns and causes of stroke differ widely between HICs and LMICs, resulting in self-contradictory requirements for acute and long-term care.[26,5,6] This is because data on stroke care in LMICs are scarce and most of the available studies are prejudiced since they are based in urban settings and reasonably resourced health-care systems. Due to this trend, the world has seen an increase in the prevalence of stroke (survivors), thus the sum of those alive with disabilities [3,9]. According to the Global

Burden of Disease (GBD) study, from 1990 to 2013the victims of stroke and an absolute number of disability-adjusted life years due to ischaemic stroke increased significantly, over the years.[3, 16] However, HICs and LMICs exhibit different trends. For example, DALYs and deaths from stroke, in proportion to all causes, increased significantly in LMICs but presented no quantifiable alteration in industrialized realms. In 2013, the proportional contribution of ischaemic stroke related DALYs and deaths were greatest in HICs, whereas for hemorrhagic stroke, the contribution was most significant in LMICs.[16]

The rising prevalence of ischemic and hemorrhagic stroke in HICs could be related to improvements in acute stroke care or more effective secondary prevention [3,26]. Furthermore, the rising prevalence of stroke in HICs could be connected to greater identification of minor stroke cases, which depends heavily on universal access to primary care. If these trends continue, the United Nations global target of a 25% reduction in premature mortality from non-communicable diseases, including stroke, by 2025 will not be met.[3] The findings above clearly show the importance of stroke as a leading global health problem that requires urgent attention from every aspect of the society. Prevention of future or current new onset of stroke incidences is the core solution to the problem of the growing stroke burden in HICs.[16,26] However, differences in the epidemiology of stroke should be taken into account when setting therapeutic goals and priorities for the process. For example, in HICs, where the burden associated with ischaemic stroke is conspicuously higher than in the LMICs, it seems reasonable to focus more significantly on reduction of behavioural risks and management of medical conditions that lead to atherosclerosis.[28] Evidence indicates that modification of health behaviours is feasible, improves health outcomes, and reduces health-care costs of managing new onset of stroke. Moreover, the changes in behaviours can arguably reduce stroke burden, an individual's risk of stroke by about 80% and can reduce stroke incidence by about 50%. Atrial fibrillation is also another important and prevalent risk factor for stroke, and there is an urgent need for better detection and wider implementation of modern treatment for this condition.[13]

Comparison of stroke care between HICs and LMICs

Stroke prevention has improved dramatically in the 21st century, with awareness and education being paramount, both in LMICs and HICs. Over the past four decades, the incidence of stroke in high-income countries have decreased by 42%, but increased dramatically by more than 100% in low and middle-income countries.[27] Studies show that from 2000 to 2008, the estimated stroke incidence rates in low-income countries surpassed those in high-income countries by about 20%.[27,18,16] The high incidence in LMICs is mostly due to the immature and resource challenged health systems, coupled with a lack of awareness and education.

Few LMICs have the necessary funding and required resources either to establish surveillance programs, or to register data for detecting the health trends in the population.[29,30]. The WHO recommends a stepwise approach to stroke surveillance approach for collecting data and monitoring trends (STEPS Stroke). A study synthesizing STEPS Stroke surveillance in nine sites in India, the Islamic Republic of Iran, Mozambique, Nigeria, and the Russian Federation, showed that STEPS Stroke surveillance is possible and feasible in low-resource settings.[30].

Screening for stroke risk factors also helps in identifying and educating those at risk in both HICS and LMICs.[31]. However, in LMICs, the cost-effectiveness of national stroke screening has not been analysed comprehensively, contrary to high-income countries where it has been studied extensively.[22]. For example, studies have shown that Eastern North Carolina in the United States, experienced a decrease in stroke prevalence and mortality after approximately 4900 community outreach risk factor screenings conducted between 2007 and 2011.[26] Due to reduced income and deficiency of awareness of screening benefits, many low-income countries end up not having any stroke screening programmes.[22,16].

The American Stroke Association introduced the best practice guidelines for stroke diagnosis that include patient history, physical examination, neurological examination and stroke scales, and diagnostic tests.[28,26]. The most widely used strategy for stroke diagnosis is the immediate Computed Tomography (CT) scanning. However, the economic burden of CT scanning in an already resource challenged setting, renders it largely unattainable. For example, plain head CT scanning in India costs 90 US Dollars, which is a significant burden in the context of the average monthly middle-class income being 500 US Dollars, coupled with a lack of universal health insurance.[21]. Therefore, LMICs still face a growing challenge to develop and distribute accessible, cheaper and reliable diagnostic equipment and technologies.[12]

Studies have shown that limiting excessive sodium intake and tobacco use, together with effective management of hypertension, are considered as the three leading risk factors for cost-effective stroke prevention.[27]. Sodium intake reduction remains a challenge for both researchers and policymakers, due to the notorious difficulty of changing lifelong dietary habits. In HICs, over 70% of sodium intake comes from processed pre-packaged food and thus the HICs residents would not be expected to benefit from the use of salt substitutes as much as the LMICs.[7,25] The majority of sodium intake in LMICs comes from salt added during cooking..[6] Salt substitutes have been shown in a meta-analysis of six clinical trials to reduce systolic blood pressure by an average of 4.9 mm Hg in adults, compared to conventional salt. Trials on salt substitutes that are to be substantiated in the future by larger trials on mortality or morbidity, suggest that a policy of subsidising and promoting salt substitutes may have potential as a useful tool in reducing sodium

intake, blood pressure and stroke incidence in LMICs. Similarly, smoking cessation campaigns need to be more widespread and effective in LIMCs as they are in HICs. Smoking cessation programs and changes in legislation to reduce tobacco use inLMICs need to be a priority for policymakers to save millions of lives and reduce smoking related morbidity over the next two decades.[3]

Optimal medical management of risk factors is considiered the mainstay for primary prevention of stroke, which addresses hypertension, dyslipidaemia, and atrial fibrillation.[13,32]. In LMICs, the awareness, treatment and control rates of hypertension is universally lower as compared to HICs.[13] LMICs are trying to find innovative and efficient strategies to overcome many health system- and socio-economic barriers. These obstacles include the inadequate curative, acute-care oriented systems, limited resources and capacity to improve identification of those at risk and to develop more comprehensive medication formularies on public and private health and pharmacy insurance plans.

Rehabilitation care and therapy play a substantial role in the stroke survivors' lives. Rehabilitation is vital as the survivors live with the consequences of the malady for a long time and often manage their resulting limitations and health status as a chronic condition. Stroke rehabilitation can be provided through hospitalization, home, and community-based programs. These arrangements may include physical, occupational, speech, and recreation therapies. The availability of and access to rehabilitation services and care for patients transitioning from their acute hospitalization varies dramatically around the globe yet worse inLMICs.[4] The LMICs characterises poor physician knowledge of the part of rehabilitation, lack of recovery component in the standard of care, the long interval from stroke onset to admission to recovery and the inadequate public insurance or financial support for rehabilitation care. These attributes composes the factors contributing to the limited availability and accessibility of rehabilitation systems in LMICs.

Significant gender and racial/ethnic disparities, the ever-increasing burden of stroke across the globe, and a trend towards more strokes in youthful people in both developed and LIMICs, all indicate deficiencies in current stroke prevention strategies. Various stroke prevention strategies can be applied. These include Population-wide, high-risk, combined approach, integrated approach procedures, and use of information technology.[14] Population-wide approaches are essential because even small changes in the distribution of risk factors could lead to major reductions in stroke incidences in the population. Promoting maintenance of health might be easier and more efficient than reversing existing damage.[4] This is one of the benefits of population-wide prevention approaches that target the entire population, rather than just those at high risk.

Changes in health practices may have a greater impact early in life before the risk factors have emerged in both HICs and LMICs. Administration policies for primary stroke deterrence in individuals at high risk should be maximised and fully utilised. The United Nations regard primary prevention of stroke as the most

cost-effective strategy to reduce the burden of stroke.[19] It is important for stroke prevention strategies to be accompanied by population-wide prevention strategies targeted at behavioural, lifestyle and environmental risks, in which responsibilities are shared between the health sector, non-governmental organizations and government bodies.

For example, resources for the development and implementation of culturally appropriate prime stroke anticipation strategies could be taken from proceeds resulting from an assessment on tobacco, salt, sugar, and alcohol. In another aspect, an integrated approach would incorporate community-clinical linkages that coordinate clinical strategies for high-risk individuals and community-based strategies to promote healthy behaviours and reduce health disparities. Technological advancements like smartphones have helped in the improvement of health awareness and research capabilities in developed and LIMICs. Mobile health apps have strategically assisted in the empowerment of people to self-manage risk factors. Stroke has also emerged as a cause of long-term disability among adults.[13]

Due to advances in medical care, the world is observing an upsurge in the pervasiveness of stroke survivors, thus the number of those alive with incapacities. Studies have demonstrated that victims who have achieved full recovery through rehabilitation still face a risk of future stroke.[2,13,28] Because of this, stroke prevention strategies have advocated people with stroke to have access to further recovery, as long as they continue to benefit from the services. The primary aim of rehabilitation is to maximise independence, facilitate re-integration into the community and enhance participation in life roles.

Prehospital Interventions that can be adopted by LMICs

Firstly, LMICs need to increase stroke education and awareness and ensure that they include the rural areas. Studies have shown that the timely identification and the quick response to the signs of stroke by bystanders is vital to enhance access to definitive care and eventually improve the functional outcomes, following the onset of stroke.[13,26] Numerous educational and awareness campaigns have been found to augment awareness of the signs and symptoms of stroke[8, 24,26].

While there has been increased enthusiasm in the prehospital field with regards to therapeutic and diagnostic interventions for stroke management in HICs, there is a paucity of research in prehospital stroke management in LMICs.[24] Although the telemedicine-based communication amid EMS and hospital workers is still developing in the HICs, the technologies have a huge potentiality to supply expertise from the health institutions to the prehospital environment.[26] Various studies have described bilateral communication systems between stroke centres and hospitals in the rural areas and prehospital staff.

Potential communication advantages include getting directions to appropriate specialised stroke centres or conducting two-way live conferencing to discuss and share information such as pictures or ECG's[11,13,20].

Identification of gaps or needs for further research

- Barriers and challenges to facilitate acute stroke care should be explored qualitatively in both HICs, as well as LMICs
- Realistic and achievable acute stroke guidelines for LMICs should be created – this should be the end result of local research and consensus processes
- Comprehensive assessments of available resources should be performed locally to inform local guidelines
- Cost-benefit analysis for acute stroke care, investigating the effect of costly interventions and comparing it to the benefits gained, should be assessed.

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Part B: Manuscript

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Title: Access to acute care resources in various income settings to treat new-onset stroke: a survey of acute care providers

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Access to acute care resources in various income settings to treat new-onset stroke: a survey of acute care providers

Abstract

Introduction

Stroke affects 15 million people annually and is responsible for 5 million deaths per annum globally. In contrast to the trend in low- and middle-income countries (LMICs), stroke mortality is on the decline in high-income countries (HICs). Even though the availability of resources varies considerably by geographic region and across LMICs and HICs, evidence suggests that material resources in LMICs to implement recommendations from international guidelines are largely unmet. This study describes and compares the availability of resources to treat new-onset stroke in countries based on the World Bank's gross national incomes, using recommendations of the American Heart Association and the American Stroke Association 2013 update.

Methods

A self-reported cross-sectional survey was conducted of delegates that attended the April 2016 International Conference on Emergency Medicine using the web-based e-Survey client, Survey Monkey Inc. The survey assessed both pre-hospital and in-hospital settings and was piloted before implementation.

Results

The survey was distributed and opened by 955 delegates and 382 (40%) responded. Respondents from LMICs reported significantly less access to a prehospital service ($p<0.001$) or a national emergency number ($p<0.001$). Access to specialist neurology services ($p<0.001$) and radiology services ($p<0.001$) were also significantly lower in LMICs.

Conclusions

The striking finding from this study was that there was essentially very little difference between the responses between LMIC and HIC respondents with a few notable exceptions. The findings also propose a universal lack of adherence to the 2013 AHA/ASA stroke management guideline by both groups, in contrast to the good reported knowledge thereof. Carefully planned qualitative research is needed to identify the barriers to achieving the 2013 AHA/ASA recommendations.

Keywords: Emergency; Low resource; Access; Stroke; Cerebrovascular accident

African relevance

- The study highlights and compares available resources between LMICs and HICs to implement clinical guidelines for acute stroke care
- It addresses the link between the high mortality of stroke in LMICs in comparison to HICs
- It describes the barriers to the implementation of reference standard clinical stroke guidelines in LMICs

Access to acute care resources in various income settings to treat new-onset stroke: a survey of acute care providers

Introduction

Stroke affects 15 million people annually and is responsible for 5 million deaths per annum globally.[1] It is a major contributor to the growing burden of non-communicable diseases (NCDs), which accounted for 68% of all deaths in 2012, up from 63% in 2008.[2] The last two decades have seen a major transformation in the field of stroke care with the emergence of evidence-based stroke detection, access to advanced care, and emergency management of stroke.[3] In contrast to the trend in low- and middle-income countries (LMICs), stroke mortality is on the decline in the high-income countries (HICs).[4,5] Even though the availability of resources varies considerably by geographic region and across LMICs and HICs, evidence suggests that the available resources in LMICs to implement international recommendations are largely inadequate.[5,6] Arguably it is unlikely that these policies and guidelines, which are almost exclusively developed in HIC settings, would similarly apply in LMIC settings at all.[6] Our study describes and compares the availability of resources required for the acute management of new-onset stroke between LMICs and HICs, as self-reported by emergency care providers working in these settings, based on the recommendations of the American Heart Association (AHA) and the American Stroke Association (ASA) 2013 stroke guideline.[3]

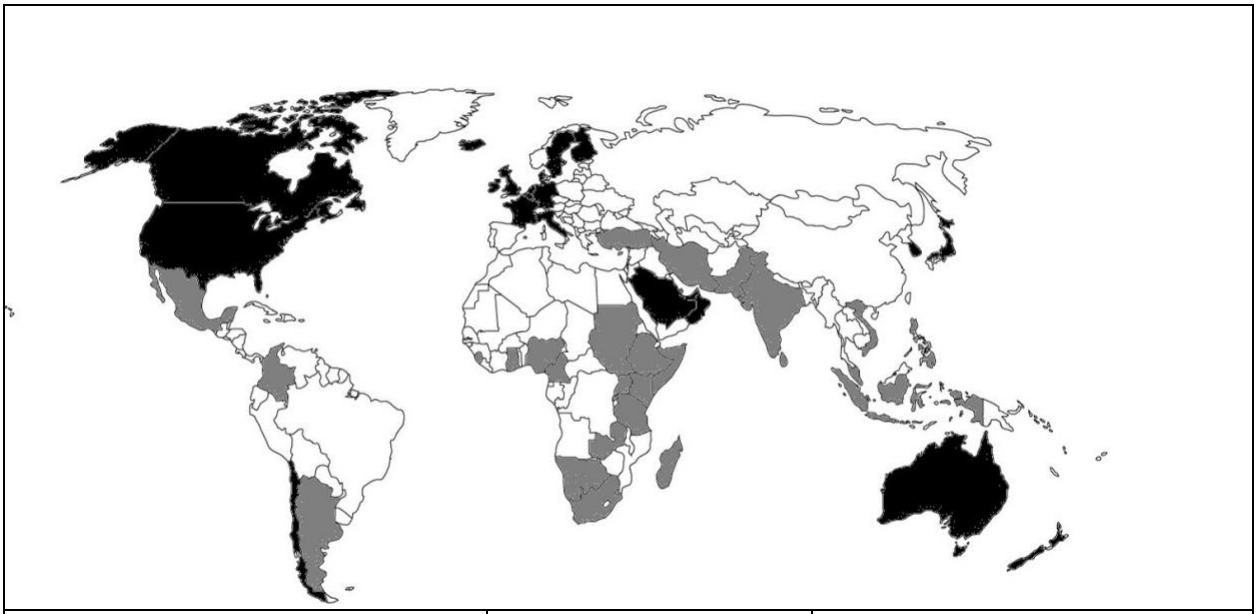
Methods

A self-reported survey, using the web-based e-Survey client, SurveyMonkey Inc. (Palo Alto, California, USA, www.surveymonkey.com), was conducted of delegates that attended the April 2016 International Conference on Emergency Medicine. We based the survey variables on the recommendations of the AHA and ASA 2013 stroke guideline.[3] Both the AHA and the ASA are reputable organisations and their guidelines are widely referenced. The survey assessed pre-hospital and/ or in-hospital settings (depending on whether participants had dual or single clinical roles) and was piloted before use (survey tool available as Appendix A). Participants described access to various pre-hospital and/ or in-hospital variables either as yes or no; or always, sometimes, never or don't know. Descriptive statistics were then used to summarise these. The strength of associations between responses from HICs, and LMICs was tested using either the Fisher's exact test or the X^2 test, depending on the sample size involved. Significance was expressed as $p<0.05$. Adherence to the AHA and ASA's main guidelines were summarized

for LMIC and HIC respondents by providing the *always* proportion of the results. This study received ethical approval from Stellenbosch University (Cape Town, South Africa) Human Research Ethics Committee (S16/03/044).

Results

The survey was distributed and opened by 955 delegates and 382 (40%) responded. We excluded 26 surveys due to incompleteness leaving 356 (37%) split as 200 (56%) from HIC and 156 (44%) from LMIC. There were 79 (21%) respondents for the pre-hospital part of the survey (split 59% from HICs and 41% from LMICs) and 303 (79%) respondents for the in-hospital part of the survey (split 56% from HICs and 44% from the LMICs). The top five countries by contribution were: United Kingdom (n=39, 20%), Australia (n=34, 17%), United States (n=24, 12%), New Zealand (n=18, 9%) and Netherlands (n=11, 6%) for HIC. It was South Africa (n=88, 56%), Tanzania (n=8, 5%), Ghana (n=7, 5%), Ethiopia (n=6, 4%) and India (n=4, 3%) for LMIC (see Figure 2).



Delegate category	High-income country	Low-and middle-income country
Physician specialist	162 (81%)	79 (51%)
Physician generalist	31 (16%)	36 (23%)
Specialist trainee	2 (1%)	12 (8%)

Nurse	2 (1%)	14 (9%)
Prehospital staff	3 (2%)	12 (8%)
Clinical officer/ physician assistant	0	3 (2%)

Figure 2: The distribution of participants and breakdown of clinical roles. Black areas indicate high income countries and grey areas indicate low- or middle-income countries represented.

Respondents from LMICs reported significantly less access to a prehospital service (split 4% from HICs and 21% from LMICs; p<0.001) or a national emergency number (split 4% from HICs and 21% from LMICs; p<0.001). Most of the respondents (301, 84%) reported that they were familiar with the 2013 AHA/ASA stroke guidelines (split 85% from HICs and 86% from LMICs; p=0.38) and the majority of respondents (305, 85%) reported familiarity with the NIHSS stroke scale (split 83% from HICs and 88% from LMICs; p=0.34).

Table 2 depicts the proportional access to resources indicated as always available for all level 1B recommendations from the AHA and ASA stroke guideline of 2013. A detailed description of individual resource availability, with breakdown of the various responses (always, sometimes, never, don't know) is provided as data supplements in Appendix D.

Table 1: Proportional access to full resources, that are 24-hours, or always available, for treating acute onset stroke in the emergency centre, for the Class 1 A and B recommendations of the AHA/ASA stroke management guideline of 2013

Income setting	Proportional access to full resources for low- and middle-income country delegates n (%)	Proportional access to full resources for high-income country delegates n (%)
Pre-hospital Availability of a national emergency number system for activation by patients or other members of the public (Class I; Level of Evidence B)	84% (148/176)	95% (178/187)
Availability of prehospital stroke assessment tools, such as the Los Angeles Prehospital Stroke Screen or Cincinnati Prehospital Stroke Scale (Class I; Level of Evidence B)	41% (13/32)	49% (23/47)

Initial management of stroke in the field (Class I; Level of Evidence B) • Access to cardiac monitoring • Access to IV cannulas • Access to point of care glucometer (access to dextrose containing solutions) • Stroke management guideline	 78% (25/32) 88% (28/32) 75% (24/32) 98% (23/32) 47% (15/32)	 74% (35/47) 87% (41/47) 79% (37/47) 96% (41/47) 49% (15/47)
Access to the most appropriate institution that provides emergency stroke care (Class I; Level of Evidence A)	41% (13/32)	32% (15/47)
Provision of prehospital notification to the receiving hospital that a potential stroke patient is en route so that the appropriate hospital resources may be mobilized before patient arrival (Class I; Level of Evidence B)	47% (15/32)	38% (18/47)
In-hospital Availability of a quality improvement committee to review and monitor stroke care quality benchmarks, indicators, evidence-based practices, and outcomes (Class I; Level of Evidence B)	48% (63/132)	46% (78/171)
Availability of an organized protocol for the emergency evaluation of patients with suspected stroke (Class I; Level of Evidence B)	73% (97/132)	68% (116/171)
Use of a stroke rating scale, preferably the NIHSS, is recommended (Class I; Level of Evidence B)	88% (140/160)	83% (165/198)
Assessment of blood glucose (must precede the initiation of Intravenous fibrinolytic therapy) (Class I; Level of Evidence B)	99% (131/132)	94% (161/171)
Access to electrocardiogram in patients presenting with acute ischemic stroke but should not delay initiation of Intravenous fibrinolytic therapy (Class I; Level of Evidence B)	95% (125/132)	90% (154/171)
Access to emergency imaging of the brain to exclude intracranial haemorrhage (absolute contraindication) and to determine whether cerebral ischemia is present (Class I; Level of Evidence A) • Non–contrast-enhanced computed tomography (CT) • Magnetic resonance imaging (MRI)	 81% (107/132) 44% (58/132)	 83% (142/171) 53% (90/171)

In intravenous fibrinolysis candidates, the brain imaging study should be interpreted within 45 minutes of patient arrival in the ED by a physician with expertise in reading CT and MRI studies of the brain parenchyma (Class I; Level of Evidence C)		
• Access to 24-hour radiology service	84% (111/132)	98% (167/171)
• Access to 24-hour neurology service	45% (59/132)	97% (166/171)
• Access to 24-hour tele-radiology service	45% (59/132)	27% (47/171)
Use of intravenous fibrinolytic therapy in the setting of early ischemic changes (other than frank hypodensity) on CT, regardless of their extent (Class I; Level of Evidence A)	83% (110/132)	80% (137/171)

Discussion

The two striking findings from this study were that there appeared to be poor adherence to the 2013 AHA and ASA stroke guideline irrespective of income-group and subsequently very little difference between the responses of LMIC and HIC respondents. Although participants reported good knowledge of the guideline and the NIHSS, adherence to clinical recommendations were overall much less enthusiastic, particularly concerning thrombolysis. In LMICs, pre-hospital service and national emergency numbers were lacking and in-hospital, significantly less access to specialist neurology and radiology services were reported. These findings fit with known reported delays in presentation and diagnosis.7,8 It is most likely also what contributes to the reported poor outcome.9-11 The reported better access to tele-radiology in LMICs were reassuring when considering the significant lack of specialised care. It is concerning that no international reference standard for acute stroke management exists that also takes into account the lack of resources and services affecting the vast majority of the global population. Such guidance is necessary to prioritise available resources appropriately; for instance, it is unlikely that intravenous thrombolysis has an important role in most LMIC settings especially where a reasonable prehospital, neurology or radiology service are lacking. Understanding limitations of care and using these to interpret scientific advances are an important part of knowledge translation. It is interesting to note that thrombolysis was not that well supported by the HIC cohort. This will need further exploring.

The small sample size and low response rate increase the risk of a type II error however we did find differences and the findings were in keeping with previously published work. South Africans were over-represented in the LMIC cohort and would likely have improved the perspective on access from a LMIC perspective. This has likely to do with the conference having been held in South Africa.

Conclusion

This paper suggests that neither HICs, nor LMICs are able to uphold a substantial number of the core recommendations for the acute management of stroke recommended for HICs. There are many biases and themes to explore in future studies that would be universal for either income setting. This will include considering the basics, such as providing tailored, acute stroke care guidance and setting up quality assessment systems that can monitor inputs and outcomes. Addressing expensive resources (such as advanced imaging) are challenging, but again, systems that prioritise acute needs within income settings can ensure that the most are done for the most. In our view carefully planned qualitative research, exploring these priorities, is needed to identify the barriers to achieving a safe standard of care and direct further quantitative research, especially in LMICs. It is worth mentioning that adherence to a stroke guideline that is truly representative of global resources would be more achievable than one that ignores a large proportion of the global population.

Dissemination of results

Results from this study was shared with the Division of Emergency Medicine at both the University of Stellenbosch and the University of Cape Town - Results were subsequently shared with local hospitals. The results were also presented at informal academic meetings at local hospitals.

Author contribution

SB, CH and RC conceived the original idea. SB and RC designed the survey tool. CH, SB and RC collected the sample. CH and RC analysed the data. CH, RC and SB drafted the manuscript. CH and SB revised it critically for important intellectual content. All authors approved the final version and agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

Conflict of interest

Drs Clint Hendrikse and Stevan Bruijns are editors of African Journal of Emergency Medicine. Neither were involved in the editorial workflow for this manuscript. The African Journal of Emergency Medicine applies a double blinded process for all manuscript peer reviews. The authors declared no further conflict of interest

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Part C: Addenda

Addendum A: Guide for authors (AfJEM – African Journal of Emergency Medicine)

https://www.elsevier.com/journals/african-journal-of-emergency-medicine/2211-419X/guide-for-authors

Addendum B: Consent Forms

Describing and comparing the availability of acute care resources to treat new onset stroke in different income settings: a self-reported survey of acute care providers at the 2016 International Conference on Emergency Medicine

Consent

<Invitation notification and first webpage of survey>

Dear prof/ dr /sr/ sir/madam,

We are conducting a study which aims to describe and compare the availability of acute care resources to treat new onset stroke in different income settings.

You have been selected to participate since you agreed to be contacted in this regard during registration. Your participation is entirely voluntarily, and non-participation will not have any negative consequences. There are no monetary benefits for participation. Please follow the personalised link to an online questionnaire. It should take less than 15 minutes to complete the questionnaire. The completion of the questionnaire will serve as implied consent. The online system will ensure questionnaires are returned anonymously; however, the system will provide us with a list of non-responders to enable us to send frequent reminders. The survey will be active till 6 May 2016. Access to the results will be limited to the research team.

The study has been approved by the Human Research Ethics Committee (Ref S16/03/044). They can be contacted at HREC Office number: 0219389657.

Please contact us if anything is unclear.

Kind regards,

Principle investigator: Stevan Bruijns

MMed candidate: Ramadhan Chunga

Co-investigators: Clint Hendrikse and Rachel Allgaier

Addendum C: Data collection sheet / survey

About you

1. Please provide your age in years: _____
2. Please indicate your gender
    a. Male
    b. Female
3. Which healthcare provider group do you belong to?
    a. Pre-hospital worker
    b. Nursing
    c. Non-physician (clinical officer/ physician assistant)
    d. Physician- generalist
    e. Physician- specialist
4. Are you currently in training in this provider group?
    a. Yes
    b. No
5. Please indicate your level of experience within this provider group
    a. Less than 5 years
    b. 5 to 10 years
    c. 10 to 15 years
    d. More than 15 years
6. Name the country in which you work most of the time in a year: _____

7. What setting describes your place of work in the above country best?

    a. Ambulance/ prehospital service

    b. Primary care hospital/ clinic

    c. Secondary care hospital (includes basic specialist care)

    d. Tertiary/ Academic hospital (includes sub- and super-specialist care)

8. What business model describes your place of work best?

    a. Privately funded only

    b. Public/ state funded only

    c. Hybrid funding (private/ public funded)

9. Are you familiar with the stroke guidelines from the American Heart Association (AHA) and the American Stroke Association (ASA)- 2013 and its addendum 2015 update?

    a. Yes

    b. No

10. Are you familiar with the National Institutes of Health Stroke Scale, NIHSS?

    a. Yes

    b. No

11. What is the place called where emergencies are received and treated in your setting? _____

12. In your country of practice; is stoke education available to the community?

    a. Yes

    b. No

13. In your country of practice are healthcare providers trained with stroke care education?

    a. Yes

    b. No

Prehospital questions

1. Do you perform any prehospital work?

    a. Yes

    <survey automatically continues to prehospital questions>

    b. No, there are no prehospital service in region where I work

    <survey automatically continues to in-hospital questions>

    c. No, there is a prehospital service in the region where I work, but I do not perform any prehospital work

    <survey automatically continues to in-hospital questions>

2. Does your setting have a universal emergency contact number (i.e. dedicated phone number for members of the community to activate prehospital services/ fire brigade/ police)

    a. Yes, although there is no national emergency contact number, we have a local emergency service contact number (optional: explain in comments box below)

    b. Yes, there is a national emergency contact number

    c. No (optional: explain in comments box below)

    <survey allows free text comments for this section>

3. Please indicate access to the following within your ambulance/ prehospital environment?

    <options: Always/ Sometimes/ Never/ Don't know>

    a. Prehospital triage protocol

    b. Use of pre-hospital stroke scale (e.g. FAST, Los Angeles stroke screen, Cincinnati pre hospital stroke scale, etc.)

    c. Prehospital stroke identification and treatment guideline

    d. Prehospital direct access to dedicated stroke service/ centre (including non-specialist stroke hospital bypass policies)

e. Prehospital pre-arrival stroke notification protocol

f. Drugs: Oxygen

g. Drugs: IV fluids- crystalloids

h. Drugs: Dextrose

i. Drugs: soluble aspirin 300mg

j. Monitoring: Saturation

k. Monitoring: Three lead ECG

l. Monitoring: Non-invasive blood pressure

m. Monitoring: Temperature

n. Tests: point of care blood glucose measurement

o. Disposables: Oxygen face mask

p. Disposables: IV cannula

q. Disposables: IV fluid giving set

In-hospital questions

1. Do you perform any in-hospital work?

    a. Yes

    <survey automatically continues to in-hospital questions>

    b. No, I do not perform any in-hospital work

    <survey automatically continues to "thank you" webpage>

2. Please indicate access to the following within your direct hospital environment?

    <options: Always/ Sometimes/ Never/ Don't know>

    a. Dedicated area for treatment of emergencies

    b. Triage service for patients on arrival

    c. Local new onset stroke management guideline

    d. Local, multi-disciplinary, quality improvement committee for stroke care

    e. Surgical stroke interventions

    (for 24-hour access select *always*, for less than 24-hour access, or access by transfer select *sometimes*, for no, select *never*)

    f. Intensive care/ high care service

    (for 24-hour access select *always*, for less than 24-hour access, or access by transfer select *sometimes*, for no theatre, select *never*)

    g. Stroke unit/ ward

    (for 24-hour access select *always*, for less than 24-hour access, or access by transfer select *sometimes*, for no, select *never*)

    h. Specialist neurology service

    (for 24-hour access select *always*, for less than 24-hour access, or access by transfer select *sometimes*, for no, select *never*)

i. Specialist neurosurgery service

(for 24-hour access select *always*, for less than 24-hour access, or access by transfer select *sometimes*, for no, select *never*)

j. Radiology service with real-time reporting

(for 24-hour access select *always*, for less than 24-hour access, or access by transfer select *sometimes*, for no, select *never*)

<if Sometimes/ Never/ Don't know selected then question k displayed)

k. Teleradiology link for external reporting service

(for 24-hour access select *always*, for less than 24-hour access, or access by transfer select *sometimes*, for no, select *never*)

l. Occupational/ physiotherapy service

(for 24-hour access select *always*, for less than 24-hour access, or access by transfer select *sometimes*, for no, select *never*)

m. Swallowing assessment for stroke patients.

(for 24-hour access select *always*, for less than 24-hour access, or access by transfer select *sometimes*, for no, select *never*)

n. Nutritionist

(for 24-hour access select *always*, for less than 24-hour access, or access by transfer select *sometimes*, for no, select *never*)

3. Please indicate access to the following drugs within your hospital environment.

<options: Always/ Sometimes/ Never/ Don't know>

a. Oxygen

b. Aspirin

c. IV fluids- crystalloids

d. IV fluids- colloids

e. Dextrose solutions of various concentrations (e.g. 5%, 10%, etc.)

f. antihypertensive drugs

g. Drugs for treatment of raised intracranial pressure (e.g. hypertonic saline, mannitol) (provide locally available drug of choice in comments box below)

<survey allows free text comments for this question>

h. antipyretics (e.g. paracetamol/ acetaminophen, etc)

i. Thrombolytic drug: recombinant tissue plasminogen Activator (tPA)

j. Parenteral anticoagulant (e.g. heparin, enoxaparin, etc.) (provide locally available drug of choice in comments box below)

<survey allows free text comments for this question>

k. Anticoagulants for deep vein thrombosis prophylaxis (provide locally available drug of choice in comments box below)

<survey allows free text comments for this question>

4. Please indicate access to the following equipment within your hospital environment.

<options: Always/ Sometimes/ Never/ Don't know>

a. Monitoring: Saturation

b. Monitoring: Three lead ECG

c. Monitoring: Twelve (12) lead ECG machine

d. Monitoring: Non-invasive blood pressure

e. Monitoring: invasive blood pressure

f. Monitoring: Temperature

g. Laryngoscope

h. Mechanical Ventilator

i. Tests: point of care blood glucose measurement

j. Tests: full/ complete blood count

k. Tests: coagulation profile

l. Tests: renal function

m. Tests: Cardiac Troponins

n. Tests: Other cardiac biomarkers (CKMB, etc)

o. Imaging: Plain film radiology: x-rays

p. Imaging: Computed Tomography Scanner (CT-scan)

q. Imaging: Computed Tomography angiography (CTA-scan)

r. Imaging: Magnetic Resonance Imaging

5. Please indicate access to the following disposables within your hospital environment.

<options: Always/ Sometimes/ Never/ Don't know>

a. Disposables: Oxygen face mask

b. Disposables: IV cannula

c. Disposables: IV fluid giving set

d. Consumables: Nasogastric/Oro-gastric tubes

e. Consumables: Oxygen nasal prongs/Cannula

f. Consumables: Urethral catheters

g. Consumables: Compression antithrombotic stockings

Addendum D: Study Data Set

Table 1: Availability of pre-hospital stroke services, drugs, disposables and equipment to implement ASA/AHA stroke guidelines for low- and middle-income, and high-income countries [n %]

Low- and middle-income countries (n=32)					High-Income Countries (n=47)			
Always	**Sometimes**	**Never**	**Don´t know**	**Variables**	**Always**	**Sometimes**	**Never**	**Don't know**
15 (47%)	10 (31%)	7 (22%)	0	Pre-arrival notification	18 (38%)	13 (28%)	14 (30%)	2 (4%)
13 (41%)	11 (34%)	8 (25%)	0	Direct access to dedicated stroke services	15 (32%)	18 (38%)	13 (28%)	1 (2%)
15 (47%)	11 (34%)	6 (19%)	0	Prehospital stroke management guideline	23 (49%)	15 (32%)	7 (15%)	2 (4%)
13 (41%)	15 (47%)	4 (13%)	0	Use of a prehospital stroke scale	23 (49%)	14 (30%)	9 (19%)	1 (2%)
25 (78%)	6 (19%)	1 (3%)	0	Use of aspirin	39 (83%)	7 (15%)	1 (2%)	0
28 (88%)	4 (13%)	0	0	Use of crystalloids	41 (87%)	5 (11%)	0	1 (2%)
23 (72%)	5 (16%)	3 (9%)	1 (3%)	Use of dextrose solutions	41 (87%)	4 (9%)	1 (2%)	1 (2%)
23 (72%)	5 (16%)	2 (6%)	2 (6%)	Access to thermometer	37 (79%)	9 (19%)	1 (2%)	0
27 (84%)	2 (6%)	2 (6%)	1 (3%)	Access to non-invasive blood pressure measurement	39 (83%)	7 (15%)	1 (2%)	0
24 (75%)	7 (22%)	1 (3%)	0	Access to point of care glucometer	37 (79%)	9 (19%)	1 (2%)	0
25 (78%)	5 (16%)	0	2 (6%)	Access to cardiac monitoring	35 (74%)	9 (19%)	3 (6%)	0
28 (88%)	4 (13%)	0	0	Access to IV cannulas	41 (87%)	6 (13%)	0	0
28 (88%)	3 (9%)	0	1 (3%)	Access to IV giving sets	40 (85%)	7 (15%)	0	0
23 (72%)	6 (19%)	3 (9%)	0	Access to endotracheal tubes	30 (64%)	13 (28%)	4 (9%)	0
23 (72%)	8 (25%)	1 (3%)	0	Access to laryngoscope	28 (60%)	15 (32%)	4 (9%)	0
16 (50%)	11 (34%)	5 (16%)	0	Access to mechanical ventilator	20 (43%)	21 (45%)	6 (13%)	0

*, $p<0.05$; **,$p<0.01$; ***,$p<0.001$

Table 2: Availability of hospital stroke services, drugs, disposables and equipment to implement the AHA/ASA stroke guidelines for low- and middle-income, and high-income countries [n %]

Low- and middle-income countries (n=132)					High-income countries (n=171)			
Always	**Sometimes**	**Never**	**Don´t know**	**Variables**	**Always**	**Sometimes**	**Never**	**Don't know**
127 (96%)	4 (3%)	1 (1%)	0	Triage service	160 (94%)	9 (5%)	0	2 (1%)
97 (73%)	13 (10%)	12 (9%)	10 (8%)	Local stroke treatment guideline	116 (68%)	25 (15%)	23 (13%)	7 (4%)
63 (48%)	24 (18%)	26 (20%)	19 (14%)	Quality improvement committee for stroke care	78 (46%)	38 (22%)	36 (21%)	19 (11%)
128 (97%)	3 (2%)	0	1 (1%)	Use of aspirin	164 (96%)	6 (4%)	0	1 (1%)
132 (100%)	0	0	0	Use of antihypertensives	166 (97%)	5 (3%)	0	0
110 (83%)	10 (8%)	11 (8%)	1 (1%)	Use of intravenous thrombolytics	137 (80%)	19 (11%)	13 (8%)	2 (1%)
117 (89%)	11 (8%)	3 (2%)	1 (1%)	Use of hypertonic solutions	148 (87%)	17 (10%)	5 (3%)	1 (1%)
125 (95%)	7 (5%)	0	0	Use of parenteral anticoagulants	155 (91%)	11 (6%)	4 (2%)	1 (1%)
131 (99%)	1 (1%)	0	0	Use of crystalloids	170 (99%)	1 (1%)	0	0
130 (98%)	2 (2%)	0	0	Use of dextrose solutions	165 (96%)	4 (2%)	2 (1%)	0
125 (95%)	6 (5%)	1 (1%)	0	Access to 12-lead electrocardiography	154 (90%)	11 (6%)	5 (3%)	1 (1%)
125 (95%)	6 (5%)	0	1 (1%)	Access to chest radiography	162 (95%)	8 (5%)	0	1 (1%)
107 (81%)	20 (15%)	5 (4%)	0	Access to Computed Tomography	142 (83%)	18 (11%)	11 (6%)	0
88 (67%)	31 (23%)	12 (9%)	1 (1%)	Access to Computed Tomography Angiography	120 (70%)	27 (16%)	22 (13%)	2 (1%)
58 (44%)	52 (39%)	20 (15%)	2 (2%)	Access to Magnetic Resonance Imaging	90 (53%)	50 (29%)	29 (17%)	2 (1%)
131 (99%)	1 (1%)	0	0	Access to point of care glucometer*	161 (94%)	10 (6%)	0	0
128 (97%)	0	1 (1%)	3 (2%)	Access to IV cannulas	170 (99%)	1 (1%)	0	0
131 (99%)	1 (1%)	0	0	Access to IV giving sets	169 (99%)	1 (1%)	0	1 (1%)
127 (96%)	1 (1%)	2 (2%)	2 (2%)	Access to endotracheal tubes	163 (95%)	7 (4%)	1 (1%)	0
130 (98%)	1 (1%)	0	1 (1%)	Access to naso-/ oral gastric tubes	166 (97%)	5 (3%)	0	0
131 (99%)	1 (1%)	0	0	Access to urinary Catheters	167 (98%)	4 (2%)	0	0

*, p<0.05; **,p<0.01; ***,p<0.001

Table 3: Availability of hospital stroke services to implement the AHA/ASA stroke guidelines for low- and middle-income, and high-income countries [n %]

Low- and middle-income countries (n=132)					**High-income countries (n=171)**			
24-hours	**< 24-hours**	**Not available**	**Don´t know**	**Variables**	**24-hours**	**<24-hours**	**Not available**	**Don't know**
59 (45%)	54 (41%)	15 (11%)	4 (3%)	Specialist neurology service***	166 (97%)	5 (3%)	0	0
111 (84%)	17 (13%)	4 (3%)	0	Radiology service***	167 (98%)	4 (2%)	0	0
43 (33%)	60 (45%)	24 (18%)	5 (4%)	Surgical stroke interventions	73 (43%)	68 (40%)	26 (15%)	4 (2%)
76 (58%)	51 (39%)	4 (3%)	1 (1%)	Occupational therapy/ Physiotherapy	100 (58%)	64 (37%)	4 (2%)	3 (2%)
59 (45%)	16 (12%)	39 (30%)	18 (14%)	Tele-radiology service**	47 (27%)	32 (9%)	61 (36%)	31 (18%)
60 (45%)	56 (42%)	15 (11%)	1 (1%)	Specialist neurosurgery	93 (54%)	64 (37%)	12 (7%)	2 (1%)
109 (83%)	15 (11%)	8 (6%)	0	High care services	141 (82%)	22 (13%)	6 (4%)	2 (1%)
69 (52%)	29 (22%)	30 (23%)	4 (3%)	Stroke unit/ward	90 (53%)	44 (26%)	33 (19%)	4 (2%)

*, p<0.05; **,p<0.01; ***,p<0.001

Addendum E: Research Protocol

Describing and comparing the availability of acute care resources to treat new onset stroke in different income settings: a self-reported survey of acute care providers at the 2016 International Conference on Emergency Medicine

Introduction

Stroke rank amongst the leading causes of death and disability worldwide[1,2] It affects fifteen million people annually and is responsible for 5 million deaths per annum globally[1,3,4]. Stroke has also been implicated as a cause of permanent disability in 5 million people worldwide[1,3,5]. It is a major contributor to the growing burden of non-communicable diseases (NCDs) along with hypertension, respiratory disorders, diabetes and cancers[6]. In 2012 NCDs accounted for 68% of all deaths, up from 63% in 2008[2]. Those below 75 years of age account for 63% of disability adjusted life years (DALYS) lost in ischaemic stroke[8,9]. Despite significant progress in stroke prevention and care, the incidence and burden of stroke is still of concern, especially in lower and middle income countries[10,11].

Stroke, along with other NCDs, have a considerable socio-economic impact on individuals, families and communities: directly including medical treatment and rehabilitation costs; and indirectly with lifestyle adjustment costs as a result of acquired disability[11]. Stroke patients also lose time seeking long term or lifetime care while those permanently disabled by it, face a lifetime loss of productivity.[6,11].

The last two decades have seen a major transformation in the field of stroke care with the emergence of an evidence-based approaches to stroke prevention, acute stroke management, and stroke recovery[12, 13,14]. In contrast to the situation in LMICs, stroke mortality is on the decline in the United States. The statement from the American Heart Association (AHA) and American Stroke Association (ASA) underlines the fact that stroke has fallen from the third to the fourth leading cause of mortality in the states. This is perhaps due to extensive resources and implementation of evidence supported by a renowned organisation [12].

The disproportionately higher burden and disparity of end points between the high-income countries (HIC) and low and middle-income countries appears largely due to multiple barriers to implement evidence-based stroke care. Sound body of evidence also suggests that material resources to replicate recommendations of evidence-based stroke care from international guidelines are largely unmet [13]. The availability of health care resources however, varies considerably by geographic region and across low, middle to high income countries[13, 14,15]. As very little data and consistency exist on resource availability to implement stroke guidelines in countries with different gross national incomes as well as World Health Organisation regions, it is unlikely that policies and guidelines developed in high income settings would similarly apply in low

and middle income settings[16]. The challenge thus lies in implementing internationally accepted guidance, particularly in low to middle income countries where resources are limited.

Various guidelines are in place worldwide to guide the prevention and early management of stroke. However, most are developed from similar resource rich settings. The National Institute for Health and Clinical Excellence, (NICE) and AHA/ASA are currently the gold standards and their recommendations are adopted all over the world. The first NICE stroke guidelines were developed in 2004 and was updated in 2008 [17]. However, the AHA/ASA developed a more recent guideline (2013), including an addendum update in 2015. It is also more reputable across the low and middle-income countries due to the fact that the emergency cardiovascular care programs implemented all over the world utilises these guidelines. In light of these attributes, this survey will examine healthcare resources to implement the AHA/ASA stroke management guideline of 2015.[18]

The aim of this study is to examine the availability and distribution of resources available for acute care of new-onset stroke patients in countries based on the world bank's gross national incomes and WHO regions-using recommendations of the American Heart Association (AHA) and the American Stroke Association (ASA) 2015 update-as self-reported by delegates attending the April 2016 International Conference on Emergency Medicine. It is envisaged that this study will aid in hypothesis generation for further research into resource availability regarding frontline treatment of new onset stroke in low to middle income settings.

Objectives

By using the results from a self-reported survey amongst international delegates attending the April 2016 International Conference on Emergency Medicine:

1. To provide a general description of the existence / availability / accessibility of new-onset stroke acute care guidelines for the World Bank's low, middle low, middle high- and high-income setting categories [18]

2. To provide a general description of equipment (drugs, equipment and disposable materials) available for the acute care of patients with new-onset stroke for the World Bank's low, middle low, middle high- and high-income setting categories [18]

3. To provide a general description of supportive resources (stroke service, neurology service, advanced imaging, etc.) available for the acute care of patients with new-onset stroke for the World Bank's low, middle low, middle high- and high-income setting categories [18]

4. To compare the interrater description of availability and distribution of resources available for the care of patients with new-onset stroke within and between the World Bank's low, middle low, middle high- and high-income setting categories [18]

    a) Sub objective: To compare the interrater description of availability and distribution of resources available for the care of patients with new-onset stroke within and between World Health regions [19]

Methodology

Study Design

A Self-reported, cross-sectional survey, using an institutional subscription to the web-based e-Survey client, SurveyMonkey Inc. (Palo Alto, California, USA, www.surveymonkey.com) will be conducted.

Characteristics of the study population

The International Conference on Emergency Medicine is the official conference of the International Federation for Emergency Medicine. The federation represents more than sixty national emergency medicine societies across the globe[20]. It is considered as "the most active, broad-based, international organization [sic] dealing with international EM [emergency medicine] development issues"[21]. Its biennial conferences attract around 2200 delegates and are the largest international gatherings of acute care clinicians, nurses and prehospital staff in the world. Delegates tend to be representatives from member, national emergency medicine societies as well as academics, emergency medicine trainees and those with an interest in global emergency medicine development.

Representation tends to be wide and includes a good spread of delegates from low, middle low, middle high and high-income settings. Approximately 2500 from over 60 countries are expected at the 2016 conference. This assumption is based on previous conference attendance; 2200 delegates from 60 countries attended the 2012 Dublin, Ireland conference and 2280 delegates from67 countries attended the 2014 Hong Kong, China conference[21]. For the 2014 conference 25% of delegates were from low to middle income countries and 48% were from the East Asia region[21]. The expectation is that African attendance would be similarly affected given the African host for 2016. To further bolster delegate attendance from low and middle low settings, sponsorship initiatives have been put in place. In addition, given that South Africa will play host,

it is expected that the conference will at least be more accessible to delegates from low and middle low settings within the sub-Saharan African region. With a target response rate of 50-60%, the sample size is estimated to be around 1200 completed surveys.

Recruitment and enrolment

All delegates registering for the conference are consented to be approached for research during registration[24]. Delegates agreeing will be approached during the conference via email and/ or using the conference smartphone application (through a directed study participation notification) to take part in the survey. All delegates who are acute care providers in the hospital setting will be eligible for recruitment. Trade and non-clinical delegates will be excluded. A link from the email/ application notification will provide access to first an informed consent (Appendix B); as a preamble to the survey and second to the survey. Participants will have to click to agree before being able to access the survey. Hence, participating in the survey will serve as implied consent. The survey will remain open for two weeks following the conference with daily reminders provided during the conference and then every three days following the conference for the remainder of the time. During the conference, delegates will be encouraged to complete the survey during the sessions. Data sets will be imported from the backend of the e-Survey client on a spreadsheet using Microsoft Excel ® (Microsoft Corporation, Redmond, WA). The e-Survey client will ensure anonymous completion of the survey from the back-end (which is not accessible to the study team in the planned full anonymous setting), allowing reminders to be sent to non-responders.

Research procedures and the survey:

The provisional study survey instrument is provided in Appendix B. It has been pretested in its current form by the study team. Variables regarding equipment and resource requirements were taken from the American Heart Association (AHA) and the American Stroke Association (ASA) 2015 update[18]

This was a minor update and the 2013 update is referenced throughout the document[12]. The survey captures demographic details of respondents: age, gender, experience (years), country, sector (public, private, mixed), discipline (medical, nursing, prehospital), and details of their place of work (out of hospital, primary, secondary or tertiary care). Equipment and supportive resources availability require one of the following answers per variable: always, sometimes, never and don't know. The survey has been drafted to follow the patient journey to allow a practical approach when being completed. Participants will be able to

skip sections that do not apply to their scope of practice. Further development following approval will include pilot testing the survey with local emergency medicine trainees (n=5), emergency nurses (n=5) and prehospital staff members (n=5). These providers will be asked to complete the survey and then to assess it with regards to adequacy, suitability, duration and organisation. Internal consistency of survey questions will be tested using Cronbach's alpha. Following feedback and review of the final version in February 2016, modifications will be made to improve the survey. The final survey tool will be published along with the findings.

Statistical analysis

The study team will use SPSS version 22 (IBM Corp, Armonk, NY) for analysis. Descriptive statistics will be used to describe individual variables. Datasets where sections have been skipped due to participant scope will be included in the final sample. Calculations will be adjusted accordingly to accommodate variable sample size differences. The median will be used to express central tendency and interquartile range to describe spread. Categorical variables will be expressed as proportions. Histograms and/ or frequency tables will be used to present the data visually. Resource variables will be arranged in terms of their ranked strength of evidence according to the American Heart Association (AHA) and the American Stroke Association (ASA) 2015 update[18]. Mann Whitney-U test will be used to compare continuous variables. Interrater agreement within and between the various income and regional categories will be assessed using weighted Cohen's Kappa. A p-value less than 0.05 will be considered statistically significant. Confidence intervals will be provided where appropriate.

Ethical considerations

Risks and benefits

Embarrassing a specific participant or facility are the main concern. An anonymous sample will help although not completely negate the risk of retrospectively identifying a participant or facility by association. There is no specific interest in individual delegates, facilities or even individual countries. Findings will be reported in categories (either according to the income groups or the World Health Organisation region). This is clearly stated in the consent, appendix B.

The findings will provide an overview of resource availability, but not a definitive answer. As very little data exist on resource availability to implement stroke guidelines in countries with different gross national

incomes as well as WHO regions, this study will provide a guide on where to focus further research into resource availability.

Consent

Participation is voluntary. Delegates identified to participate in the survey will have already consented to be approached for research during the conference registration process; conference registration includes a section which the delegate has to agree to being approached, or not. This reads as follow:

"The gathering of so many international emergency care workers in Africa is unprecedented, and as such poses an important opportunity for research during the conference. All research conducted during the conference will have received permission from the conference scientific committee. This permission is not in place of the requirement for Ethical (IRB) approval for individual studies. South Africa's Protection of Personal Information Act regulates the processing of personal information and requires consent from an individual to make use of demographic as well as corresponding information. I consent to be approached to take part in research around the ICEM 2016 conference. I understand that this consent does not imply my consent to participate in individual studies: □ Yes/ □ No"[24]

A link from the email/ application notification will provide access to first an informed consent (as a preamble to the survey) and second the survey. Electronic consent will be taken prior to commencing the survey (see Appendix B). Participants will have to click to agree before continuing the survey.

Confidentiality

The survey will be programmed with the full anonymous setting in place. The e-Survey client will ensure anonymous completion of the survey with the back-end (which is not accessible to the study team) allowing reminders to be sent to non-responders.

Reimbursement

Participants will not be reimbursed for participation.

Dissemination

Findings will be shared with the International Federation for Emergency Medicine executive committee. A poster presentation of findings is anticipated at the African Conference on Emergency Medicine to be held in Cairo, November 2016. A peer reviewed publication is also anticipated.

Study Limitations

By including only ICEM 2016 delegates, the survey will most likely introduce selection bias (due to respondent clustering). It is possible that delegates from underserved rural hospitals, which make up the crucial part of healthcare services in low to middle income settings, may be underrepresented. The results may therefore overestimate the true situation of resource availability to treat new onset stroke in low to middle income settings. Much is done by the conference organisers to ensure attendance from such delegates. As described earlier, the 2014 conference had 25% representation from low to middle income settings and 48% regional representation. Within an African context that would be a huge contribution to delegates low to middle income settings. Nevertheless, this will be hard to predict in advance and results will have to be interpreted in lieu of the findings, bearing this bias in mind.

It is also possible that the evaluation and availability of material resources may not shed light to shortage of trained healthcare providers among both LMICs and HIC income settings, which may impact stroke care. The design of the survey is to provide precursor material for hypothesis generation for potential future studies[13,15]

Data collected via surveys lack details and depth on the specific research topic; however, this study is intended to provide baseline knowledge on the availability of resources across different countries. Follow-up, in-depth interviews to acquire more knowledge can be done if so, indicated by the results. A poor response rate is also possible and may introduce bias. Regular reminders (as described earlier) will be sent to participants in an attempt to keep the response rate as high as possible. A similar study performed at a conference held in Kenya in 2011 to describe sepsis resources, had a 74% response rate[14]. We have estimated a more conservative number as described earlier.

There is an assumption that, some respondents may misunderstand certain questions despite the pre-testing of the survey described earlier. It is also possible that language problems will contribute to misunderstandings. Some respondents may choose to answer only some of the questions. The conference is being conducted in English and all promotional material have thus far been provided in English. The

expectation is that the vast majority of participants will understand a sufficient amount of English to complete the survey.

Project Timeline:

Table 2: *Project Outline*

2015	**DEC**	**JAN**	**APR**	**MAY-NOV**		**DEC**
Departmental Research Committee						
Ethics						
Data Collection						
Transcribing of Data						
Data Analysis						
Compilation of findings						
Presentation of findings						
Manuscript, Posters for publishing/ Dissemination						

Budget:

The cost of this study will be borne by the investigators. Costs are estimated below:

Table 3: *Budget*

Principal Investigator	R 0
Consulting services	R 0
Statistical services	R 0

Travel	R 500
Conference registration	R 0
Equipment & Furniture	R 0
Computer	R 0
Telephone, cell phone, fax	R 100
Internet & e-mail	R 100
Printing, copying & binding	R 1000
Ethics committee fee	R 0
Total costs	R1700

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Addendum F: HREC Approval

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Approved with Stipulations

New Application

06-May-2016
Allgaier, Rachel R

Ethics Reference #: S16/03/044

Title: **Describing and comparing the availability of acute care resources to treat new onset stroke in different income settings: a self-reported survey of acute care providers at the 2016 International Conference on Emergency Medicine**

Dear Ms. Rachel Allgaier,

The **New Application** received on **11-Mar-2016**, was reviewed by members of **Health Research Ethics Committee 1** via Expedited review procedures on **04-May-2016**.

Please note the following information about your approved research protocol:

Protocol Approval Period: **06-May-2016 05-**

May-2017 The Stipulations of your ethics

approval are as follows:
The MMed student should be registered as the principal investigator for this study.

Please remember to use your **protocol number** (**S16/03/044**) on any documents or correspondence with the HREC concerning your research protocol.

Please note that the HREC has the prerogative and authority to ask further questions, seek additional information, require further modifications, or monitor the conduct of your research and the consent process.

After Ethical Review:
Please note a template of the progress report is obtainable on www.sun.ac.za/rds and should be submitted to the Committee before the year has expired. The Committee will then consider the continuation of the project for a further year (if necessary). Annually a number of projects may be

selected randomly for an external audit.
Translation of the consent document to the language applicable to the study participants should be submitted.

Federal Wide Assurance Number:0001372 Institutional Review Board (IRB) Number: IRB0005239

The Health Research Ethics Committee complies with the SA National Health Act No.61 2003 as it pertains to health research and the United States Code of Federal Regulations Title 45 Part 46. This committee abides by the ethical norms and principles for research, established by the Declaration of Helsinki, the South African Medical Research Council Guidelines as well as the Guidelines for Ethical Research: Principles Structures and Processes 2004 (Department of Health).

Provincial and City of Cape Town Approval

Please note that for research at a primary or secondary healthcare facility permission must still be obtained from the relevant authorities (Western Cape Department of Health and/or City Health) to conduct the research as stated in the protocol. Contact persons are Ms Claudette Abrahams at Western Cape Department of Health (healthres@pgwc.gov.za Tel: +27 21 483 9907) and Dr Helene Visser at City Health (Helene.Visser@capetown.gov.za Tel: +27 21 400 3981). Research that will be conducted at any tertiary academic institution requires approval from the relevant hospital manager. Ethics approval is required BEFORE approval can be obtained from these health authorities.

We wish you the best as you conduct your research.
For standard HREC forms and documents please visit: www.sun.ac.za/rds

If you have any questions or need further assistance, please contact the HREC office at 0219389657.

Investigator responsibilities
Protection of Human Research Participants

Some of the responsibilities investigators have when conducting research involving human participants are listed below:

1. Conducting the Research. You are responsible for making sure that the research is conducted according to the HREC approved research protocol. You are also responsible for the actions of all your co-investigators and research staff involved with this research.

2. Participant Enrolment. You may not recruit or enrol participants prior to the HREC approval date or after the expiration date of HREC approval. All recruitment materials for any form of media must be approved by the HREC prior to their use. If you need to recruit more participants than was noted in your HREC approval letter, you must submit an amendment requesting an increase in the number of participants.

3. Informed Consent. You are responsible for obtaining and documenting effective informed consent using **only** the HREC-approved consent documents, and for ensuring that no human participants are involved in research prior to obtaining their informed consent. Please give all participants copies of the signed informed consent documents. Keep the originals in your secured research files for at least fifteen (15) years.

4. Continuing Review. The HREC must review and approve all HREC-approved research protocols at intervals appropriate to the degree of risk but not less than once per year. There is **no grace period.** Prior to the date on which the HREC approval of the research expires, **it is your responsibility to submit the continuing review report in a timely fashion to ensure a lapse in HREC approval does not occur.** If HREC approval of your research lapses, you must stop new participant enrolment, and contact the HREC office immediately.

5. Amendments and Changes. If you wish to amend or change any aspect of your research (such as research design, interventions or procedures, number of participants, participant population, informed consent document, instruments, surveys or recruiting material), you must submit the amendment to the HREC for review using the current Amendment Form. You may **not initiate any** amendments or changes to your research without first obtaining written HREC review and approval. The **only exception** is when it is necessary to eliminate apparent immediate hazards to participants and the HREC should be immediately informed of this necessity.

6. Adverse or Unanticipated Events. Any serious adverse events, participant complaints, and all unanticipated problems that involve risks to participants or others, as well as any research-related injuries, occurring at this institution or at other performance sites must be reported to the HREC within **five (5) days** of discovery of the incident. You must also report any instances of serious or continuing problems, or non-compliance with the HRECs requirements for protecting human research participants. The only exception to this policy is that the death of a research participant must be reported in accordance with the Stellenbosch University Health Research Ethics Committee Standard Operating Procedures www.sun025.sun.ac.za/portal /page/portal/Health_Sciences/English/Centres%20and%20Institutions/Research_Development_S

upport/Ethics/Application_package

All reportable events should be submitted to the HREC using the Serious Adverse Event Report Form.

7. Research Record Keeping. You must keep the following research-related records, at a minimum, in a secure location for a minimum of fifteen years: the HREC approved research protocol and all amendments; all informed consent documents; recruiting materials; continuing review reports; adverse or unanticipated events; and all correspondence from the HREC

8. Reports to the MCC and Sponsor. When you submit the required annual report to the MCC or you submit required reports to your sponsor, you must provide a copy of that report to the HREC. You may submit the report at the time of continuing HREC review.

9. Provision of Emergency Medical Care. When a physician provides emergency medical care to a participant without prior HREC review and approval, to the extent permitted by law, such activities will not be recognised as research nor will the data obtained by any such activities should it be used in support of research.

10. Final reports. When you have completed (no further participant enrolment, interactions, interventions or data analysis) or stopped work on your research, you must submit a Final Report to the HREC.

11. On-Site Evaluations, MCC Inspections, or Audits. If you are notified that your research will be reviewed or audited by the MCC, the sponsor, any other external agency or any internal group, you must inform the HREC immediately of the impending audit/evaluation.

Addendum G: ICEM Local Organising Committee Approval

ICEM CAPE TOWN 2016
EM NOW: KNOWLEDGE, ACTION & ACCOUNTABILITY
18-21 April 2016 • Cape Town International Convention Centre
www.icem2016.org

1 February 2016

Dear Dr Bruijns

Re: Research at the International Conference of Emergency Medicine 2016

Thank you for contacting us regarding the four surveys that you and your study team wish to disseminate during the conference. It is noted that the project includes the following four studies listed below:

1. Describing and comparing the availability of acute care resources to treat new onset stroke in different income settings: a self-reported survey of acute care providers at the 2016 International Conference on Emergency Medicine
2. Describing and comparing the availability of acute care resources to treat acute coronary syndrome in different income settings: a self-reported survey of acute care providers at the 2016 International Conference on Emergency Medicine
3. Describing and comparing the availability of acute care resources to treat major trauma in different income settings: a self-reported survey of acute care providers at the 2016 International Conference on Emergency Medicine
4. Describing and comparing the availability of acute care resources to treat sepsis in different income settings: a self-reported survey of acute care providers at the 2016 International Conference on Emergency Medicine

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Emergency Medicine Society of South Africa (NPC)

We agree to the following with regards to data collection and promotion of the surveys during the conference:

1. All prospective delegates have to agree at registration whether or not to be directly approached for research during the conference. Only delegates' contact details who have consented/ agreed at registration will be provided to the study team for recruitment.
2. Prospective participants can be approached through the conference smartphone application (through a directed study participation notification) to take part in the survey. Please send survey links and text at least 30 days prior to the conference starting.
3. Where possible, we will promote the research project during the plenary sessions although this will not be considered a priority. We agree to promotion being done through the various notification screens that will be placed throughout the venue. Please send survey links and text at least 30 days prior to the conference starting.

Best of luck for your research endeavour.

Yours sincerely

Dr Melanie Stander

LOC Chair ICEM

2016